Introduction and reasons for attempting this research topic

Squamates (i.e., lizards and snakes) occur throughout most continents except for Antarctica, flourishing across a wide array of different environments, from the lush tropical jungles to the arid deserts and from the tiniest rivers to the vast remote oceans. These reptiles are astonishingly diverse, comprising more than 10,000 different species today. Extant squamates include many iconic and popular forms, while also a considerable number of species is important for medicinal and pharmaceutical purposes.

Europe and the nearby Mediterranean regions of Africa and Asia have a rather complex geological history and a series of climatic fluctuations during the Cenozoic (65 Million years ago to today), which lead to major dispersal and extinction events that tremendously affected its ecosystems. This area hosts a nowadays modest diversity of lizards and snakes, when compared to the respective vast numbers of different species and morphologies observed throughout the tropics of the planet. Nevertheless, the fossil record attests for a much greater and fascinating diversity during the Cenozoic past of that area, witnessing a number of amazing forms, extreme sizes, and peculiar anatomical features. However, we practically know little about the extinct Cenozoic squamate faunas of this area, especially as it regards the affinities of several enigmatic fossil forms, their causes of extinction, and the origins and biogeography of most extant groups. As such, this current lack of knowledge has a tremendous impact on our understanding of the emergence and evolution of modern herpetofaunas.

Project goal and description of research

With this OPUS project, I aim to advance our current knowledge of the fossil record, taxonomy, biogeography, and evolution for the Cenozoic squamates of Europe and the Mediterranean portions of Africa and Asia. I plan to describe an array of new fossil lizard and snake specimens from many different localities throughout that area, with ages spanning throughout the past 65 million years. The majority of this fossil material consists of abundant disarticulated, though well preserved, remains, but there are also complete articulated skeletons. The latter, articulated skeletons are embedded on matrix and represent extremely rare cases in the fossil record. As I have done in my previous research with other fossil skeletons, I plan to study these complete specimens with the aid of micro-computed tomography scanning (m-CT scanning), a non-destructive technique which allows a 3D reconstruction of whole specimens, even those parts that are not directly visible. Such reconstruction will then allow a comprehensive understanding of the skeletal anatomy, functional morphology, and ecological adaptations of these enigmatic animals. As for the remaining, abundant and diverse disarticulated specimens, these are of utmost importance because many of them exhibit peculiar, distinctive anatomical features and/or originate from geographic areas that have so far not been adequately explored from a palaeontological perspective. Beyond systematics though, I will use this novel information from the new fossil material for thorough analytical studies: along with detailed datasets of all known fossil occurrences of squamates from the area, which I have been compiling, I will investigate the fossil record of these reptiles across this whole region and for across the whole Cenozoic, testing extinction events, dispersals, endemism patterns, and diversification for each lizard and snake clade.

Substantial results expected

Studying these new fossil remains will allow me to thoroughly investigate their skeletal anatomy and identify important distinguishing features. This will then afford valuable data to clarify their exact affinities with other reptiles (by conducting phylogenetic analyses) and allow me to propose novel diagnostic features that can be subsequently used for taxonomy and fossil identification. I anticipate that studying these new fossil remains will result in the discovery and establishment of several new taxa and the documentation of new skeletal anatomies, adaptations, and evolutionary novelties in the squamate fossil record.

Most importantly, all this novel taxonomic and anatomical information, coupled with a detailed survey of all existing Cenozoic squamate literature, will allow me to conduct a more detailed investigation of the patterns surrounding the evolution and fossil record of lizards and snakes throughout the past 65 million years and across large geographic areas in Europe and the circum-Mediterranean. More particularly, such analytical approach of the fossil record will allow to identify key events and answering major questions, such as: how were squamates affected during the major Cenozoic faunal dispersal and extinction events, whether and how climatic changes had a role on these extinctions, whether there is a correlation of the survivorship or extinction of certain squamates with the absolute body size or diet or locomotion, as it has been suggested for different mammal groups, how the appearance of new immigrant squamate taxa in the region affected the existing squamate lineages, what patterns of endemism and provincialism can be observed in squamates, and when and where the extant families and genera appear in the area.